DOCUMENT RESUME

ED 056 859 SE 012 102

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TITLE Education in Marine Science and Technology--Historical and Current Issues.
PUB DATE 27 Dec 67
NOTE 21p.; Presented to the American Association for the Advancement of Science, December 27, 1967

EDRS PRICE MF-$0.65 HC-$3.29
DESCRIPTORS *College Science; Curriculum; Earth Science; Employment Trends; *Manpower Development; *Marine Technicians; Ocean Engineering; *Oceanology; *Scientific Manpower

ABSTRACT

This review of marine science and technology education and related issues was presented to the American Association for the Advancement of Science, December 27, 1967. Areas reviewed include manpower supply and demand, oceanography education history, oceanography and the social sciences, training of technicians, the ocean engineer, education for oceanography, school survey problems and recommendations, and students' problems. (PR)

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EDUCATION IN MARINE SCIENCE AND TECHNOLOGY - HISTORICAL AND CURRENT ISSUES

Presented to the American Association for the Advancement of Science, December 27, 1967

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Introduction

In six years with the Interagency Committee on Oceanography, I participated in responses to between 40 and 50 reviews, examinations, surveys, hearings, and sundry investigations of what was then called the National Oceanographic Program. Among these, most predominant questions concerned oceanographic manpower and training--education of oceanographers and numbers available to conduct programs then in force and envisioned for the future.

Owing to continual focus upon this commonality among all examinations of ocean programs, it was inevitable that eventually a major conference of some sort would be devoted to the subject. In fact, just one month ago, the American Society for Oceanography sponsored "Manpower for Oceanography--An Education Symposium." The meeting brought together heads of most of the departments of oceanography in American schools, distinguished scientists and engineers in the field, and several industrial leaders. More than twenty papers encompassed questions relating to university curricula, the relative merits of undergraduate versus graduate programs, post doctoral careers, definitions and purposes of education in oceanography, problems facing students in oceanography, enrollment statistics, projections of demand, and the growing need for ocean engineers and technicians.

Obviously I cannot cover all of these topics, even superficially, in the time allotted me this afternoon. Respecting all of those reviews,

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however, I have often wondered what would have happened had this particular question never been raised in the first place. Even supposing we can realistically calibrate the supply/demand indices and conduct accurate measurements, will this in itself prove useful? Would the resulting knowledge allow us to modify advantageously the quality or quantity of students being educated in oceanography and oceanic development?

Is it now possible that the only meaningful approach to the situation involves the posing of really pragmatic questions, such as:

a. Are graduating students getting ocean-related jobs?

b. Would they have gotten these jobs without oceanographic training?

c. Are employers finding persons to do the jobs that need doing?

d. Are the employers competant and are there enough of them?

Supply/Demand

We ("we" being the federal organizations and various societies) have been haranguing, influencing, and otherwise stimulating the academic community and the public for several years now. Student enrollments have been rising significantly, out of proportion to total numbers of students in all subjects. Whereas the number of doctorates in all fields rose from about 10,000 in 1960 to nearly double that figures in 1966, the number of PhD's granted at 10 oceanographic centers selected by the President's Science Advisory Committee increased by nearly an order of magnitude in the same period. Fifty high schools in the U.S. are including units in marine science in general science curricula and this number may double in the next year. Even grammar schools are now introducing students to glories of the sea.

last fiscal year, the Office of Education granted $½ million to establish 7 centers specializing in ocean science education at the elementary and secondary levels.

Consequently, when Dr. Maxwell asked me to address this subject, I couldn't help wondering whether his request were not predicated on a subconscious memory of a conversation we had had many years ago. We had agreed on a prediction that eventually this area would break loose, and if uncontrolled, could result in oceanographers coming out of the woodwork.

A Panel on Oceanography of the President's Science Advisory Committee (PSAC) has examined this possibility. Their report, "Effective Use of the Sea," counted 763 graduate students working towards degrees in 1965. They also noted that this could hardly be considered a complete list since oceanography had been identified in several schools outside of their arena of examination. They estimated a rate of increase of about 18 percent per year and a doubling time of four and one quarter years, finally commenting forebodingly that "if this trend, which probably has continued for a considerable length of time, prevails for only one more doubling period to Fiscal Year 1970, the number of students will exceed 1,500." Their conclusion was that "this rapid increase if accompanied by a continuation of the present budget, can only lead to major problems some two to four years hence."

Although this degree of pessimism may not be wholly warranted, some problems could arise in the future, depending on what scientific discoveries and technological accomplishments will have taken place and the degree to which the business world will have capitalized or failed to capitalize on these accomplishments.

The subject was covered more broadly in a symposium on manpower

theory and policy issues sponsored by the Commission on Human Resources and Advanced Education a year ago. Dr. John Folger, Director of the Commission, predicted that within the foreseeable future the supply of professional persons, including doctorates, was quite likely to exceed the demand, if expressed in the form of research funds. He offered three approaches to probable inadequacies of research demand:

a. A generalization of the doctorate to allow its traditional channelling toward research careers to be broadened to teaching and/or professional service.

b. To limit output of students by raising standards for admission to graduate programs.

c. To leave the problem alone and allow the market to work it out.

As can well be imagined, Dr. Folger's provocative statements met with considerable argument; most of the participants took sharp issue with his predictions of demand. Further, it should be pointed out that oceanography presents certain problems unusual in the field of education. First of all, although the time required to attain the doctorate from the baccalaureate has been reduced considerably over the past three or four years (from about 7 to 4 or 5), the graduate oceanography curriculum is still significantly more arduous than the average. This in itself tends to slow down the rate of emergence of oceanographers trained at the doctorate level.

Second, the average proportion of teaching time spent by a typical faculty member at an oceanographic Institution is lower than that for a member of a graduate school faculty, generally. This requires that the ratio of staff to student population be higher in oceanography than for other subjects generally. This in turn means that demand for university faculty itself will take longer to catch up with student

populations in oceanography than in other fields of study. Coupled with increasing student populations themselves, these factors will tend to pusy well into the future, that point where supply can meet demand.

Third, under the same rationale respecting the variety of backgrounds contributing to studies of oceanography, oceanographers in turn are likely to contribute to several other fields.

However, the major reason why I personally cannot get excited at the prospect of over production of oceanographers stems from an examination of the history of education in oceanography.

History

This history is as complicated as the interdisciplinary nature of the field itself and I would propose to deliver a far sketchier outline of its development than the excellent summation presented by Dr. Richard H. Fleming of the University of Washington in Houston last month. Until World War II, oceanography was treated as a matter of science and taught as such to exclusion of practical technology (except for fisheries).

In the 1950's, Father Neptune's prophets and disciples received aid from both the National Academy of Sciences and the Congress who had become aware of the importance of this new area and sensitive to educational problems involved in its development. An unexpected boost was received from Sputnik. Since it became quite acceptable to use Soviet efforts as yardsticks by which to measure our own, it was discvoered that Russia had been quite but busy in the ocean.

Then:

a. Congress formed a subcommittee on oceanography.

b. More than twenty federal agencies joined in common cause, establishing the Interagency Committee on Oceanography with special panels on research and education.

c. The federal budget for oceanography rose approximately 20-30 percent for about four years, highlighting research and education.

d. One university after another discovered that people who had been hitherto minding their own business in departments of biology, geology, etc., had really been oceanographers all the time. Curricula in oceanography were glued together as fast as deans could spell ONR.

Dr. Fleming describes the progress of education in marine sciences, growing from two degree granting institutions--Washington and Scripps--in the 30's to a few universities with strong, legitimate curricula, often founded by missionaries from Scripps. Thus, in the forties and early fifties, the original two schools were joined by the Universities of Columbia, New York, Rhode Island, Oregon State, Texas A&M, Johns Hopkins, and Miami. Then, dean department heads--all university administrators--began to confront unusual and complicated problems occasioned by the interdisciplinary nature of oceanography and nebulous character of its terminology (i.e., what is an oceanographer?).

Accordingly, during the late fifties and early sixties, schools organized for ocean science and technology in several ways, ranging from miscellaneous offerings, through institutionalized approaches which mobilized talents in several departments, to separately identified departments and degree oriented curricula.

For all this apparent lack of deliberate planning and careful organization, most of these curricula and educational activities proceeded very well indeed as attested to by the quality of the students emerging from them. By 1960 it was quite easy to identify several centers of excellent oceanographic education as well as several other places where related courses in marine science were offered.

As the Interagency Committee on Oceanography, and the other entities devoted to causes of advancing research and education in the

marine sciences, took time out for some honest soul searching, they decided that it was about time that the tax payer received some return on his increasingly heavy investment--specifically, toward what applications should ocean studies now be directed? This utilitarian aim had the connotation of making things work in the oceans, and thus was born the phrase "ocean engineering." From the not yet matured community of oceanographers there now emerged the ocean engineer, and although a few universities had ongoing programs in technology, several of them now began to think in terms of sophisticated fishing techniques and aquaculture, ocean mining, drug recovery, etc. This, of course, further complicated the education and training problem since schools of fisheries, mining, and public health were wheeled into action.

Introduction of the Social Sciences

Naturally, at this point state governments and industry decided that they too wanted a piece of the action and organized and recruited accordingly. It now became apparent that science and engineering offered only partial solutions to the problem of exploiting the ocean--we had to face the fact that our problems are largely institutional in nature and are amenable to social science treatment, e.g. law of the sea, economics of resource recovery, administration of oceanographic programs, etc. For instance, industry is hesitant to invest dollars in the sea on a large scale until rights are clearly defined--international law and economics.

This new matrix has led to a new phase in thinking on the part of several eminent persons concerned with education and training in oceanography, particularly where the education and research programs blend. Schools of public administration (e.g. Wisconsin, Stanford, MIT, American, and Miami) are currently looking to the oceans for important new topics upon which they may concentrate attention. Graduate students

have been assigned research studies in resource recovery problems, economic planning, waterfront development, etc. This three dimensional (science/application/social science) concept has much in its favor, allowing for the first time logical and comprehensive urban and economic planning studies which not only consider water areas but even start with them, working landward for a change.

At the present time, a realistic examination of the education problem could easily lead to massive coronaries on the part of university planners. The student now confronts an academic meat grinder in which he is to partake not only of the traditional morsels of chemistry, mathematics, biology, geology, and physics, related to the oceans; he is now tempted by the engineering possibilities inherent in ocean development. Formal engineering curricula demonstrate irresistable expansion, responding not only to the explosive growth of new science and technology, but also to the pressing demand for better understanding of the social sciences and humanities. This demand is just as critically important to the oceanographer who constantly confronts interdisciplinary and institutional situations in his profession. Incidentally, it is proposed that this burgeoning academic demand upon the student is partly responsible for the development of a growing gap between the functions of the highly educated engineer and those of the skilled mechanical grades, but more of this later.

The picture that I have been painting for you began to develop familiar overtones to certain persons in the field who noticed similarities to the most successful federal government effort in our history--the land grant program. The next step was inevitable: several scientific, industrial, and Congressional leaders teamed up to design and legislate into being, the National Sea Grant Program. For those interested, I have brought several copies of this Program's descriptive brochure.

Technician Training

Responses to several of these problems have been programatic in nature and establishment of new programs traditionally attracts new groups. While, as I have said, responsibility for education in marine science was in its early stages restricted to a few large universities who owned all of the resources of teaching and research talent and facilities, later, smaller but enthusiastic colleges got into the act. Now, more recently, a large number of junior colleges have become interested in the possibilities of formal ocean technician training--a concept of educating technicians who can assist scientists and engineers in nearly all phases of ocean science and technology.

Jobs envisaged include operations and observations at sea, the more elementary analyses of oceanographic data, the design and fabrication of instruments, and of course the training of other technicians. While only one or two schools had recognizable curricula for training ocean technicians prior to 1965, and only five today, at the present time at least 20 schools are known to be planning such curricula.

A survey recently presented in California identified nearly 4,000 technical job openings in the next five year period in 80 organizations in that state alone. These openingswere identified as marine-related technical jobs and the average annual salary was listed at over $7,500. Although some of the jobs were held by persons with bachelor's degrees, most of them were being occupied by technicians at non-degree levels. Misunderstanding still clouds the vistas opened up by the emergence of formal ocean technician training programs. A few scientists with whom I have spoken apparently envision rosy futures--they see themselves lying back, lost in pure thought, surrounded by myriads of mother's helpers. In reviewing the new chemical technician program of the American Chemical Society, it is apparent that enthusiasm will have to

be tempered by realism. There is a possibility that people will simply not want to become ocean technicians.

The American Chemical Society recently sponsored a conference on chemical technicians in Brooklyn. It was the general feeling of the participants that although planning has been good, student response is still lagging. The principal reason given was that definition of the role to be played by the chemical technician was quite recent. Apparently there is a problem in "getting out the news."

Several of our major industries have sponsored meetings to explain industrial requirements for technicians. Various schools have conducted conferences in an attempt to erase the social stigma attached to the title "technician" and to increase its attractiveness to students. The ACS has recently stated that the chemical technician's greater training in practical laboratory work and in data collection can often make him more attractive to industry than the student trained more academically with the bachelor's degree. Clearly, the same comparison should hold true with respect to oceanography.

Unfortunately, oceanography recruitment must overcome an additional handicap--the requirement for long periods away from home. This handicap may be severe in both positive and negative directions; for instance, it may be just as important to weed out persons who want to become ocean technicians because they conceive this as an open door to treasure hunting or because they are essentially sociological misfits, as it will be to attract competent persons from student ranks.

To summarize the history of ocean education in a sentence, in two generations we have watched a succession of expressions of need for scientists trained in basic disciplines, for oceanographers, and very recently for ocean engineers, technicians, and social scientists.

I am personally very enthusiastic over the manner in which this succession of interest has developed, principally because none of it

has been substitutive. Rather, as each concept has emerged from the mental drawing board, it has become integrated into our professional thinking, thus continually broadening and sophisticating our approach to marine problems. For this reason I foresee a continual strengthening of the marine science community in both nature and numbers, and increased development in terms of systems.

It was partly in recognition of this growth that the Sea Grant Program evolved, wherein is clearly specified the need for this three dimensional look at the ocean: natural science, social science, and engineering.

The Ocean Engineer

Development of the term "ocean engineer" has not been greeted with universal enthusiasm within the engineering community. Some eminent engineers have deplored the establishment of a defined program of ocean engineering and the appellation "ocean engineer" as a "gimmick" to siphon funds from legitimate engineering programs, engineering curricula, and engineering enterprises. The argument normally concerns the fact that engineering has always been oriented along disciplinary lines (e.g., chemical engineering, mechanical engineering, electrical engineering, etc.), whereas this is engineering devoted to a mission and a geography and as such would cross organized lines of instruction.

This argument should take note of the successful histories of aeronautical engineering and mining engineering for proper perspective. To quote Jay Forrester of MIT and the National Academy of Engineering,

"the future direction of engineering is obscured by the unclear role into which the engineer has fallen. Engineering education and engineering folklore have remained relatively unchanged over the past four decades, while the world of the engineer and the kind of engineering student have drastically shifted." Dr. Forrester claims that engineering education would appear to have stood still to an outside observer relative to changes in our social and economic system, but that the real content, professional depth, and foundation of science have not reflected the increased sophistication of national growth.

On the other hand, the actual world of the engineer has changed, He has become a corporate employee, now merely a cog in the corporate machine rather than a unique professional individual analogous to the medical doctor and lawyer. In a final thrust, Dr. Forrester states that "in short, the engineer, who at one time was the educated and elite leader in matching science to society, is fast becoming just another member of the industrial labor pool." Dr. Forrester calls for a re-examination of the entire engineering social system, focusing on the gap in the upper elite sector of engineering practice; it will create the interprise engineer.

It seems to me this is precisely the environment into which the ocean engineer should properly be thrust. He would be responding to the needs of ocean technology, developed in the broader environment of our national interests, whether they be military or civilian, cultural or economic, industrial or academic. Hopefully, some of the Sea Grant Colleges may some day spawn such engineers.

Education for Oceanography

Proper academic preparation for oceanography has always been a dominent conversation piece in marine science circles. Traditionalists favor acquisition of a strong background in a basic science at the bachelor's level upon which may be constructed a fairly broad lore in various phases of oceanography including chemical oceanography, physical oceanography, marine biology, and submarine geology, at the master's level. Specialization leading to the doctorate via a research project would be accomplished by applying the previous ground work in the basic science to its appropriate counterpart in the oceans.

The PSAC implied that it may not always be desirable to emphasize oceanography training per se, even at the graduate levels. They suggest the achievement of academic and research capabilities in one of the basic sciences through the doctorate followed by ocean study, perhaps at a postdoctoral or independent research level.

Several years ago, as related by Dr. Fleming, the American Society of Limnology and Oceanography listed prerequisites in essential courses for academic curricula in oceanography. Drs. Revelle and Redfield at one time recommended scholastic preparation for oceanography; they placed heavy emphasis on mathematics and on the physical sciences almost to the exclusion of the humanities.

It seems to me that in examining this problem, one faces a diverging series; the more we explore the subject, the more the possibilities that open up. With the expansion of the science itself, with the discovery of new potential applications, with the increasing disclosures of the enlarging impact of the social sciences, it will become less and less feasible to approach the study of the oceans with any sort of rigidly

structured curriculum. Even now, at our relatively primitive state of utilization of ocean science and technology, it is extremely difficult, if not impossible, to conceive of any field the academic preparation for which cannot conceivably be applied to ocean study.

I would personally prefer to take the easy way out and leave the matter to the law of supply and demand. As the student emerges from school with scientific preparation, no matter how remote, if the target exists, if given proper counseling and exposure, a certain minimal perception, and a good share of enthusiasm, he will find a way to employ his knowledge usefully. "Usefully" is meant to imply real contribution, over and above mere acquisition of employment.

School Surveys

Another problem confronting colleges and universities who are attempting to enhance their curricula concerns the national trend toward regimentation. The continuing growth of committees, panels, and task forces each with its missionary zeal to obtain the perfect program and the perfect plan to make it work, is expressing itself through countless communications to all of these schools: What are they teaching? Why are they teaching? How many are they teaching?

A recent publication of the National Science Foundation, Systems for Measuring the Reporting the Resources and Activities of Colleges and Universities, calls attention to the increasing need for the schools themselves as well as the federal agencies to have more reliable and accurate data on activities of colleges and universities. But the report, at the same time, emphasizes that "however, the measuring, recording, and reporting of these data are in a state of confusion. University officials

are flooded with questionnaires sent out independently by many different agencies; these questionnaires overlap, employ different terminologies and catagories, and in general, fit no pattern which may guide the university in the original preparation of basic data. The effort of the universities to handle a vast number of requests for data is further complicated by a lack of correspondence among the measuring and recording procedures and the cataloguing of data by different agencies." The report goes on to complain about the crudity of schools' responses as overworked and desperate officials seek to reply as quickly and as simply as possible to the deluge of questionnaires. This report, coordinated by Vice President Henle of St. Louis University, made four major, general recommendations:

a. That a comprehensive, multi-purpose, compatible, open-ended information system be developed (the report goes on to present the basis for this development on a national scale).

b. That a permanent agency undertake to coordinate the separate data systems now in use and facilitate communication and consultation.

c. That pilot demonstrations be initiated in various types of colleges and universities.

d. That the need be recognized for information systems compatible between higher education and lower levels and between the communities of education, science, and public life.

Again returning to the original question, my response would not be calculated to encourage a continuance of these surveys, questionnaires, and other examinations. I would prefer to allow the law of supply and demand and all of its implications for private enterprise to at least be

considered if not permitted to control the situation entirely.

The kinds of employment reports that are developed by industries and schools are mostly sufficient to indicate whether oceanographers will get useful jobs. More importantly, the kinds of symposia that we are holding today, technical seminars continually held throughout the country, and the papers published therein, will aid in identifying those who have accomplished and those who can accomplish. They will be the principal means by which the proper men are attracted to areas in which they can contribute. Oceanographic education will continually need and stand improvement but it should be improvement dictated by practical needs and available resources.

Students' Problems

Possibly the finest treatment of the problems besetting the student in oceanography was set forth by Gordon Reilly several years ago at an education manpower symposium. Dr. Reilly listed several special problems uniquely affecting the graduate student in oceanography:

a. The time required (at that period) to achieve the doctorate averaged seven years from the baccalaureate. This, of course, was far greater than that for almost any other field.

b. This extra time in itself imposed special problems; for instance, during these extra years, this graduate student was far more apt to be getting married and raising a family, thus constituting an extra drain upon his energy and his resources.

c. At a time when most other fathers are tending to their families, the graduate student in oceanography was spending his time at sea, away from home.

d. This extra time in the field, at sea, was not only the principal reason for the extra time requires to obtain the degree; it also prohibited him from holding down a conventional job, a means of income. This, of course, constituted an additinal barrier to raising a family.

e. A conventionnal form of income for graduate students, i.e., assisting in undergraduate classes or laboratories, was denied the oceanographer owing to lack of undergraduate courses in oceanography.

f. Students got seasick.

Several of these problems have been largely alleviated. In the first place, partly owing to greatly increased numbers of graduate students and faculties, graduate schools of oceanography have learned to tailor their courses more efficiently, thus reducing time required to attain degrees, to three to five years in some cases. Secondly, federal agencies have responded to the stated need and have provided generous assistance to graduate students. The Office of Naval Research, National Science Foundation, Office of Education, and Bureau of Commercial Fisheries have been conspicuously enlightened in this regard.

It is expected that the National Sea Grant Program will provide further assistance. However, this program will not for the time being, foster fellowships or scholarships but be limited to assistantships; this doctrine is based on the philosophy that in giving aid higest priority should go to students who are willing to help themselves.

In examining the document published biennially by the Interagency Committee on Oceanography, University Curricula in Oceanography (for the academic years):

a. Surprisingly, the number of schools listed has not increased enormously since the first edition in 1962, from 50 to 65,

but the number of available courses per school has increased reflecting the inputs from engineering schools, etc. For example, 4 schools have dual or triple programs in marine science and engineers and fisheries: Rhode Island, MIT, Hawaii, and University of Washington. Moreover, 11 additional degree granting programs have been identified since publication of University Curricula for the Academic Year 1967-68.

b. Most of the schools recently added to the listing do not offer curricula in oceanography per se but rather collections of courses peripheral to the marine sciences. In some cases, relevance of these courses is questionable, and in fact future issues of this publication will have to be carefully edited to defend against the inclusion of organizations simply wishing to climb on the bandwagon.

c. Infusion of the social sciences is not yet evident. In context of what has been said previously, this addition will enhance the national program and contribute to a more well-rounded student.

d. Some of the applied aspects of marine science have yet to receive sufficient attention. In a Gulf University Research Corporation seminar last year, Harvey Bullis, Director of the Bureau of Commercial Fisheries, Pascagoula, Mississippii laboratory, called attention to a dearth of fisheries courses. Using the University Curricula in Oceanography as his reference, Bullis counted a total of 22 courses in fishery subjects (+11 related courses) in the aggregate curricula of over 50 colleges. Only two of these courses were directly concerned with operational level problems of fish production.

Several years ago the director of one of the leading institutions in oceanography, in responding to an oft repeated charge (in those days) that oceanographers, by-and-large, were not quite as creative or academically astute as other scientists, commented that owing to the small numbers of students interested in oceanography, it was the practice to accept approximately one out of two or three students applying to graduate schools. It was his hope then that eventually this ratio could be increased to one out of five or even ten students. This is indeed the situation today. Owing to the various stimuli introduced into the system, students are applying to graduate school in increasing numbers, allowing these schools to accept a very small fraction of those who apply. This was mentioned by several of the speakers at the American Society for Oceanography symposium last month. While extremely encouraging in the sense of ensuring a higher calibre student, it is hoped that this rejection rate will not result in a backlash, i.e., a depressant on the system so that students may become increasingly reluctant to enter this field.

Conclusion - More Surveys

To return to my original theme, the supply/demand prediction problem has not even been approached, much less solved, to anyone's satisfaction. The only safe prediction is that still more surveys are on the way. The most comprehensive of them--that conducted in 1964 by the International Oceanographic Foundation and sponsored by the National Science Foundation has just been repeated in an effort to determine trends. A comparison of results gives the impression that everything has about doubled:

a. Total responses meeting the criteria of being engaged in scientific and technical work in oceanography increased from

2,649 to 5,765. Those deemed fully qualified rose from 929 to 1,934. 631 oceanographers per/se in 1964 became 1,059 in 1967.

b. Federal employees in all aspects of oceanography increased from 894 to 2,693; those employed state and locally from 228 to 282; university staffs from 737 to 1,235; while industrial employment reflected the biggest jump, from 181 to 560.

c. The number of students increased from 464 to 783--a sizeable discrepancy from the number uncovered by the PSAC survey.

d. Still considering the broad category (excluding students); the number of bachelor's degree holders increased from 921 to 2,137; master's from 487 to 1,004; and doctorate's from 536 to 975.

Time allowed me today permits no more than that brief announcement: the extended tabulations will be included and interpreted in the publication. One point screams for utterance, however. The deadly bias caused by failure to uncover industrial employment in the first survey is only partially overcome in this follow-up. We know that the apparent tripling in industrial employment figures reflects more the discovery of persons employed but previously ignored than it does a true rise in employment. On the other hand, a combination of spot checking and intuition leads one to believe that the latest statistic still falls short of true representation, almost totally ignoring, for instance, firms without government contracts.

Accordingly, and in conclusion, there will be more surveys. The Marine Sciences Council and the President's Commission are now geared into action; they have already begun to assess the census. A few of their contractors have been developing, and will continue to develop new questionnaires. For all the fundings, estimations, results, and

conclusions of each, yet another survey will be conducted with increasingly relentless, dogmatic zeal, until someday, that last, super-elusive little high school junior making his daily claim flat observation just off Great Hachinpongo Inlet and otherwise minding his own business, will have finally been successfully run to earth.